On April 7, 1997, Canada and the United States signed the *Great Lakes Binational Toxics Strategy: Canada-United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes* (Binational Toxics Strategy). The Binational Toxics Strategy identified twelve bioaccumulative substances having sufficient toxicity and presence in water, sediments and/or aquatic biota of the Great Lakes system to warrant concerted action to eliminate their input to the Great Lakes. They are called "Level 1 substances." Hexachlorobenzene (HCB) is one of the Level 1 substances. HCB is the subject of this report, which is in response to the "Challenge" written in the strategy:

> *Seek, by 2006, reductions in releases that are within, or have the potential to enter the Great Lakes Basin, of HCB from sources resulting from human activity.*

To guide Environment Canada (EC) and the United States Environmental Protection Agency (EPA), along with their partners, as they work toward virtual elimination of the strategy substances, the strategy outlined a four-step analytical framework:

1. Information gathering

2. Analyze current regulations, initiatives, and programs which manage or control substances

3. Identify cost-effective options to achieve further reductions

4. Implement actions to work toward the goal of virtual elimination

An analysis of the first two steps in this four-step framework has been documented in a previous report entitled *Great Lakes Binational Toxics Strategy Final Report for Hexachlorobenzene (HCB): Sources and Regulations*. That report identified the sources of HCB in the U.S. and assessed existing regulations and programs and their influence on the presence of HCB in the Great Lakes Basin.

This report documents the analysis associated with Step 3 of the four-step process for HCB reductions in the U.S. Step 3 encompasses identifying options that may offer opportunities for new or modified approaches, pollution prevention programs, or other alternative measures, which may accelerate the pace or increase the level of reductions, taking into account cost-effectiveness. In implementing the Binational Toxics Strategy, EC and EPA agreed to favor "cleaner, cheaper, and smarter" ways of preventing or reducing pollution from strategy substances in a common sense, practical approach to achieving environmental objectives. The governments also agreed to share scientific information and work with other nations toward international accords that address strategy substances, and to collaborate in and support voluntary initiatives by major use and release sectors and others to reduce and eliminate the use, generation, and release of strategy substances. These commitments will be taken into account in identifying possible cost-effective options to reduce HCB within the Great Lakes Basin.

The purpose of this report is to present potential reduction opportunities for achieving the Binational Toxics Strategy challenge goal for HCB. It is not intended to recommend specific actions for EPA. The potential reduction opportunities presented in the report should be evaluated by EPA, in conjunction with stakeholders, to determine which actions are most appropriate for strategy efforts.

Section 2 of this report provides a brief summary description of HCB. Further information on the sources, exposure routes, toxicity, effects on human health and the environment, and relevant programs and lists to which HCB has been nominated is provided in the Steps 1 and 2 report, "*Great Lakes Binational Toxics Strategy Final Report for Hexachlorobenzene (HCB): Sources and Regulations*". Section 3 of the report provides a brief description of each source category, followed by reduction options, including, where possible, a description of the proposed action, the release reduction potential, its cost effectiveness, implementation issues (e.g., technical feasibility), and where to find additional information. A few examples of successful efforts to reduce HCB are highlighted in Section 4.

C A U V T 1 W 1 T S

Hexachlorobenzene (CAS registry number 118-74-1) does not occur naturally. It was formerly used as a seed fungicide, but commercial production in the U.S. was discontinued in 1976. HCB is formed as a byproduct in several industrial chemical manufacturing processes, in aluminum casting, and in the chlorination treatment of process water and waste water. HCB is also released to the environment during the application of pesticide formulations which contain HCB as a residual contaminant, and during waste incineration of chlorine-containing materials.

HCB is a highly persistent environmental toxin. It undergoes long-range transport in the atmosphere and bioaccumulates in fish, marine animals, birds, and animals that feed on fish. HCB accumulates significantly in the fatty tissues and is resistant to biodegradation.

The primary route of exposure for the general population is dietary ingestion of foods that contain residue levels (ppb range) of HCB. Occupational exposures via inhalation and dermal contact occur for workers involved in processes where HCB is generated as an inadvertent byproduct, including chlorinated chemical and pesticide production, waste incineration, metals processing, and aluminum plasma etching.

HCB is toxic by all routes of exposure. Both EPA and the International Agency for Research on Cancer (IARC) have listed HCB as a possible carcinogen for humans. Acute high-dose exposures can lead to kidney and liver damage, central nervous system excitation and seizures, circulatory collapse, and respiratory depression. Chronic low-dose exposures may damage a developing fetus, cause cancer, lead to kidney damage, liver damage, and fatigue, and cause skin irritation.

Due to its persistence, bioaccumulation, and toxicity, HCB is targeted for control or regulation under various programs. Such programs include the Clean Air Act, the Clean Water Act, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). HCB is also listed as a “Bioaccumulative Chemical of Concern” (BCC) under the *Final Water Quality Guidance for the Great Lakes System*, designated as a “Lakewide Critical Pollutant” in Lakewide Management Plans (LaMPs), identified as a critical pollutant by the International Joint Commission, included in the development of protocols to control and reduce persistent organic pollutants (POPs) and heavy metals under the United Nations Economic Commission for Europe Convention on Long Range Transboundary Air Pollution (LRTAP), and approved as a candidate substance for the development of a North American Regional Action Plan by the Commission for Environmental Cooperation under the North American Agreement on Environmental Cooperation.

D A 1 1W 1 V U T X 1 V V R V

This section identifies the major sources of HCB (as given in the HCB Steps 1 and 2 report), briefly describes the source, and then discusses reduction opportunities. It should be noted that, in general, both releases and environmental loadings of HCB have decreased significantly over the past thirty years. The reduction opportunities presented here are proposed as opportunities to continue on a path toward virtual elimination of HCB.

D B T R V U 1 V

Source Characterization

HCB is generated as an impurity during the production of chlorinated solvents, such as carbon tetrachloride, perchloroethylene, trichloroethylene, ethylene dichloride, and 1,1,1-trichloroethane. Distillation is used to obtain high-purity finished products, so that the solvents themselves are not a source of HCB. However, the process wastes contain HCB, and these wastes are incinerated or placed in secure disposal facilities. Trace amounts of HCB are released during incineration as fugitive air emissions or stack emissions, or in waste water (Bailey, 1999).

Chlorinated solvents are no longer produced in the Great Lakes region. However, because long-range atmospheric transport may contribute significant amounts of HCB from sources outside the basin, actions taken to reduce HCB emissions outside of the Great Lakes region may help reduce loadings within the basin. According to 1997 TRI reports, the HCB reduction potential for chlorinated solvent manufacturing in the U.S. is 149 lbs for air releases and 250 lbs for water releases.

Reduction Options

The primary reduction option would involve identification and implementation of possible and practicable process changes or waste management practices that will capture the HCB that escapes during manufacturing operations. Source facilities may be identified from the 1996 National Toxics Inventory and/or Toxics Release Inventory (TRI) reports. Partnerships with these facilities or industry trade association and EPA could explore the practicality and cost implications of process changes to achieve further reductions. Potential cost savings resulting from the elimination of or reduction in process wastes might serve as an incentive for facilities to implement process changes. Outside consultants may be required to review processes and make recommendations regarding process modifications and other pollution prevention techniques. An example of how such a partnership can work is provided in Section 4 in the description of Dow Chemical's partnership with NRDC in the Michigan Source Reduction Initiative.

D C V T U V 1 R W R T V

Source Characterization

HCB is generated as an impurity in the synthesis of chlorinated pesticides. EPA regulates the maximum allowable concentrations of HCB as a contaminant in the following pesticides: atrazine, chlorothalonil, dimethyltetrachloro-terephthalate (DCPA), lindane, pentachloronitrobenzene (PCNB), pentachlorophenol, picloram, and simazine. The maximum allowable limits are not necessarily the levels of HCB contained in products, and manufacturers routinely cite lower actual levels. For example, HCB is not routinely detected in atrazine, simazine, and lindane (Jensen, 1999). According to information obtained from pesticide manufacturers, HCB concentrations range from 8 to 50 ppm in picloram, from 18 to 26 ppm in chlorothalonil, from 700 to 3000 ppm in DCPA, and up to 500 ppm in PCNB (Benazon, 1999). The HCB reduction potential for releases from facilities in SIC code 2879 (agricultural chemicals) reporting to TRI, using 1997 TRI data, is 31 lbs for air and water releases combined.

Reduction Options

Given the low level of manufacturing releases, industry stakeholders have raised concerns that pursuing further reductions in HCB releases may not be not cost-effective. However, taking actions to reduce the content of HCB in several currently used pesticides (as discussed in Section 3.3) may be an important step in reducing the overall environmental burden caused by application of these pesticides. Zeneca has reduced the HCB content of chlorothalonil from a maximum of 500 ppm to an average of 22 ppm (Benazon, 1999), and TRI reported HCB releases (water) for the company have decreased from 26 lbs to 4 lbs between 1997 and 1998.

The primary reduction opportunity then, lies with other pesticide manufacturers, or an industry trade association, that can commit to reducing the HCB content of pesticides. Reduction opportunities may include process modifications, waste management practices, or tighter specifications for input chemical purity. Because these would be voluntary measures not required by regulation, costs and benefits will need to be carefully assessed from a life cycle perspective to determine the practicality of achieving reductions.

D D V T U V 1R T R

Source Characterization

Although HCB is only a trace contaminant in pesticides, its high volatility results in much of it becoming a fugitive emission from the point of application. Pesticides known to contain HCB include dacthal (DCPA), chlorothalonil, picloram, pentachloronitrobenzene (PCNB), and pentachlorophenol (PCP). Since major manufacturing sources of HCB in the Great Lakes Basin are few, the use of these pesticides may constitute a significant proportion of local HCB emissions.

Reduction Options

As discussed above, efforts by pesticide manufacturers to reduce the content of HCB in currently used pesticides, particularly DCPA, would reduce HCB emissions at the point of use. Potential HCB reductions resulting from these actions would depend on the quantity of HCB-containing pesticides applied. Other options for reducing HCB emissions from the application of HCB-containing pesticides focus on reducing the use of these pesticides. These include:

- ♦ Development of community outreach programs that promote alternative lawn and turf management practices and reduce the use of pesticides and chemical-based fertilizers. The Green Thumb Project is one such program in the Duluth, Minnesota and Superior, Wisconsin area that aims to increase awareness of the impact of pesticides and fertilizers on the Great Lakes ecosystem. Efforts should include scientific information on alternatives and the advantages, disadvantages, and potential risk of using different pest management practices. The potential HCB release reduction of such actions depends on the success of the community outreach programs in reducing pesticide usage. More information about the Green Thumb Project and informational materials that have been developed as part of the project may be obtained from the Environmental Association for Great Lakes Education at (218) 726-1828 or http://www.cpinternet.com/~lakes/eagle.html.

- ♦ Cooperate with and distribute information from the federal Pesticide Environmental Stewardship Program. This program works with farmers and commodity groups to reduce agricultural and nonagricultural pesticide risk. Information is available on the use of biologically produced pesticides, the use of genetically engineered pest resistant plants, annual grants to researchers to develop low-risk pesticides or to reduce the use of pesticides, and urban outreach to increase awareness of the risk of pesticide use. Distributed to community and ag-extension service offices, this information may help to implement the outreach programs described above. Where possible, the concept of the Pesticide Environmental Stewardship Program may be extended to a program specifically for homeowners to emphasize the importance of applying manufacturer recommended rates in order to avoid over-application.

- ♦ Promote the collection of pesticides at household and agricultural hazardous waste collections (commonly called Clean Sweeps) in the basin and seek funding to continue these programs or to initiate collections in under-served areas. Not only will these result in the collection of canceled pesticides such as DDT, but they will also allow for the collection of currently used pesticides that contain HCB. The combination of Clean Sweeps with outreach programs that encourage alternative forms of pest control will help to ensure that HCB is not released from improper disposal of surplus or unwanted pesticides.

D E T T T 1T U V 1R U 1 V V U R V 1 U T

Source Characterization

One facility that is engaged in cyclic crude and intermediate production reported fugitive HCB air emissions of 14 lbs in 1997. Over the previous four years, 12-15 lbs of HCB have been consistently reported by this facility.

Reduction Options

Since total HCB releases reported to TRI in 1997 for cyclic crude and intermediate production were relatively low, it may be sufficient to simply monitor the TRI releases reported for this sector. If a significant increase in HCB releases is reported, further action would then be warranted. An alternative option is to contact the one facility reporting HCB releases for this sector to try to determine the source of the fugitive emissions and to identify a solution to the problem.

D F T V T R 1 R W R T X K 1 R R V 1 R U 1 T V

Source Characterization

Four chemical manufacturing companies reported HCB air and water releases to TRI totaling 385 lbs in 1997. HCB has been reported to result from the electrolytic production of chlorine using graphite anodes (USEPA, 1999). Although the conversion from graphite to metal anodes is thought to have occurred industry-wide, it appears that HCB continues to be generated as an inadvertent byproduct during the manufacture of chlorine and caustic soda at a few facilities.

In 1997, HCB releases reported to TRI were 135 lbs to air, 250 lbs to water, 139 lbs for underground injection, and 6 lbs for off-site transfers. These releases were reported under TRI threshold level requirements in place in 1997. Under these requirements, only facilities that manufacture or process 25,000 lbs or otherwise use 10,000 lbs of a listed chemical were required to report to TRI. On October 29, 1999, an amendment to lower the TRI reporting threshold to 10 lbs per year for persistent, bioaccumulative, and toxic (PBT) substances, including HCB, was finalized. The rule, which became effective with the 2000 reporting year, is expected to capture smaller, less visible and/or less well-regulated sources.

Reduction Options

Reduction opportunities may be available for companies currently reporting to TRI or for smaller facilities suspected of releasing HCB that may not have met the previous TRI reporting threshold levels. The source of HCB generation, whether from metal anodes or from facilities that continue to use graphite anodes, may need to be investigated. Reduction commitments may be sought from chemical companies reporting known HCB releases to TRI in the chlor-alkali sector. One such commitment has already been made by Dow Chemical Company, which has set a goal to reduce HCB emissions/releases to air and water by 75 percent by the year 2005.

Sharing Dow's methods for meeting this goal may facilitate HCB reductions at other chemical companies.

For smaller facilities that do not currently report to TRI, outreach and education will help ensure the facilities understand and follow the new reporting requirements. This may provide information on the magnitude of releases from smaller facilities and the need for further action. The facilities should be informed of the new TRI reporting threshold (10 lbs) and invited to attend TRI training courses offered by EPA. The training courses will familiarize facilities with TRI reporting requirements and procedures, as well as regulatory changes and how they affect regulated facilities. More importantly, the courses will provide training to industry in completing the appropriate TRI forms, helping to ensure that toxic releases are reported. There is no registration fee for these training courses. [More information concerning TRI training courses can be found at http://www.epa.gov/tri/training.htm.]

D G 1 1 T 1 T V V

Source Characterization

A Miscellaneous Organic NESHAP (National Emissions Standard for Hazardous Air Pollutants), or MON, is being proposed for miscellaneous organic chemical production or processes. This standard will affect approximately 150 facilities that produce the following types of chemicals: benzyltrimethylammonium chloride production, carbonyl sulfide, chelating agents, ethylidene norbomene, explosives, hydrazine, photographic chemicals, rubber chemicals, symmetrical tetrachloropyridine, paints, and adhesives. These processes are distinguished from those in the Synthetic Organic Chemical Manufacturing Industry (SOCMI), which are covered under a separate regulation. HCB emissions have been reported for a few of these processes, such as the production of explosives, paint, and rubber chemicals (Bailey, 1999; SMOC, 1998). Estimated HCB emissions from the draft 1993 National Toxics Inventory (NTI) for MON–Continuous Processes were 250 lbs (Pope, 1999).

Reduction Options

The anticipated standard for these processes will require 98% control of hazardous air pollutant (HAP) emissions for miscellaneous organic chemical batch processes with over 10,000 lbs of HAP emissions per year (McDonald, 2000). The need for further reduction actions may be determined after evaluating emissions reported in the 1996 NTI (which is yet to be released). A first step in obtaining reductions would be to verify HCB emissions from source facilities, identify large or small producers, and list control processes or devices that can be used. Appropriate incentives may need to be offered to smaller producers that use little or no control.

D H U T T 1 R T U 1 U T

Source Characterization

HCB emissions have been reported for hydrochloric acid (HCl) production in the draft 1993 NTI (Pope, 1999). Over 90% of the HCl produced in the U.S. is captured as a byproduct in the manufacture of chlorinated organic chemicals such as vinyl chloride. Most of the remaining HCl is produced via direct synthesis from the burning of hydrogen and chlorine gases. A small percentage of the HCl comes from other manufacturing processes such as incineration of chlorinated organic waste gases, reaction of sulfuric acid with metal chlorides, and production of fumed silica. HCB may be generated during the manufacture of HCl by chlorinated organic chemical production and incineration of chlorinated organic wastes. However, emissions from both of these processes are regulated under the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Hazardous Organic NESHAP (HON), which requires emission standards to control organic HAP emissions. Estimated HCB emissions from the draft 1993 NTI totaled 85 lbs (Pope, 1999).

Reduction Options

Since HCB emissions from HCl production are largely controlled by the SOCMI HON, the potential for further reductions in HCB may be minimal at this time.

D I V T U R 1 R 1 T V X

Source Characterization

The use of hexachloroethane (HCE) in aluminum foundries and remelting plants to remove hydrogen gas bubbles from molten aluminum yields a number of organochlorine compounds, most notably HCB (Westberg, et al., 1997). There is an apparent trend to move away from HCE usage in secondary aluminum operations, and only a few foundries in the U.S. are reported to presently use HCE in aluminum degassing operations (Bailey, 1999).

Since very few foundries are thought to currently use HCE, the source of HCB may be limited to a few companies or sites. Based on information from the Aluminum Association (1999), source contributions may be as much as 562 lbs.

> [Using information from experimental aluminum degassing with HCE (Westberg, et al., 1997), the rate of HCB emissions from the process is calculated as 5.2×10^{-6} lbs HCB/lb aluminum alloy. The Aluminum Association (1999) reports 54,000 tpy of aluminum produced by secondary smelting facilities thought to be using HCE. From this information, potential HCB emissions from secondary aluminum facilities using HCE can be calculated as (5.2×10^{-6} lbs HCB/lb aluminum alloy) x (54,000 tons aluminum) x (2,000 lbs/ton) = 562 lbs HCB]

Reduction Options

The first step in achieving reductions will be identification of those secondary aluminum foundries presently using HCE and discussions with them of the documented feasibility of alternative degassing substances (e.g., argon or nitrogen gas). Voluntary cooperation from the few foundries identified as potential users of HCE may require innovative approaches that offer, for example, monetary incentives, technical assistance to implement process changes, or tax breaks.

Source Characterization

Formation of HCB as a result of incomplete combustion of chlorinated substances has been reported for municipal waste, medical waste, hazardous waste, and sewage sludge incinerators, as well as for cement and aggregate kilns (Benazon, 1999; Cohen et al., 1995). Numerous municipal and medical waste incinerators of various size categories, and several hazardous waste incinerators and cement kilns are located in the Great Lakes Basin. HCB emissions from waste incinerators vary by facility, depending on the type of waste incinerated, the equipment used in the combustion process, and air pollution controls installed.

While the potential for reduction of HCB releases from waste incineration is uncertain due to the variability of fuels and combustion conditions and the minimal testing that has been conducted, Bailey (1999) provides rough estimates of HCB emissions from waste combustion in the U.S. In this study, the geometric mean of several emission factors reported in the literature is used to calculate an estimate of HCB emissions from municipal waste combustion. Using the volume of U.S. municipal waste incinerated in 1995, average HCB emissions may be about 1,900 lbs, with a range of 200-19,000 lbs, and an uncertainty factor of 100 (Bailey, 1999). (It appears, from the emission factors used in the calculation, that this estimate reflects the level of emissions before implementation of the MACT standards for municipal waste combustion units.) For hazardous waste combustion, medical waste incineration, cement production, and sewage sludge incineration, Bailey (1999) estimates an average of 146 lbs of HCB emissions in the U.S. From these estimates, the total release reduction potential for waste incineration in the U.S. is approximately 2,000 lbs.

Reduction Options

In the U.S., MACT standards have been promulgated for large municipal waste combustion (MWC) units and proposed for small MWC units; however, facilities burning less than 35 tons per day are not currently subject to regulation. MACT standards have been promulgated for three categories of medical waste incinerators. MACT standards have also been promulgated for hazardous waste combustors. For cement kilns, MACT standards have been promulgated under the hazardous waste combustors rule and Portland cement kilns rule (for non-hazardous waste burners). The implementation of these regulations is expected to reduce HCB emissions. The significant technology upgrades that have occurred at cement kilns in the last five to ten years are also expected to lower emission levels. In addition, as part of the MACT process, a residual risk analysis is required and standards must be developed to address any remaining risks from source facilities after implementation of the MACT. Given the likelihood that current control technology required under the MACT standards will result in a reduction of HCB releases, and given the effort required to implement and meet the MACT standards, it appears unlikely that there are cost-effective options for further HCB reductions through additional control technology.

In addition to MACT regulations for municipal waste combustion units, medical waste incinerators, and cement and lightweight aggregate kilns burning hazardous waste, other efforts focused on pollution prevention for these source sectors may also reduce HCB.

Possible pollution prevention options, building on existing efforts, include the following:

- Expand the WasteWise Program, which is a national voluntary program that encourages businesses to reduce and recycle their wastes.
- Educate residents, business owners, and commercial organizations on ways of recycling and reusing materials and purchasing recycled products.
- Promote process improvements and practices that reduce or eliminate waste before it is generated in household, commercial, and industrial settings. Many of these approaches not only benefit the environment, but are also relatively inexpensive to implement and more efficient and more cost-effective for the business or organization.

Source Characterization

HCB was detected in an emissions characterization study undertaken by EPA to quantify emissions from the simulated burning of household waste material in barrels (EPA, 1997a). In this study, the total emissions of chlorobenzenes from approximately 100 non-recycling open-burning households was estimated to equal the emissions from one “well-operated full-scale” municipal waste combustor unit.

The prevalence of open trash burning in the Great Lakes is not certain, but is thought to be common in rural areas where there are fewer waste removal alternatives. In a survey of 760 residents of northeast Minnesota and northwest Wisconsin, 28% of all respondents currently use a burn barrel or other device to burn household garbage or other materials (Zenith Research Group, 2000). In this study, 45% of respondents indicated that convenience was the primary reason for burning garbage, and the primary material burned was paper.

There is currently no federal legislation that addresses open barrel or backyard trash burning. Various state, local, and tribal regulations govern the practice, but enforcement may be a low priority.

Reduction Options

Open barrel/backyard trash burning is estimated to potentially release significant amounts of dioxins and furans per year and has been identified as a high priority for the Binational Toxics Strategy Dioxin Workgroup. Open trash burning is also a concern due to B(a)P emissions. Therefore, reduction options for HCB from open barrel/backyard trash burning may be coordinated with reduction efforts of the Dioxin and B(a)P workgroups. Options include:

- Increase the ease of recycling and alternative means of disposal to discourage open burning. This may require assessing policy, infrastructure, economic, and other barriers to eliminating waste disposal by open burning, particularly in rural areas. The degree to which the convenience factor can be addressed will be key to reducing the practice. The economics and feasibility of trash pickup or convenient drop-off locations to recycle paper, cardboard, junk mail, and other items that are routinely burned need to be understood and documented. Based on this understanding, strategies for increasing the convenience of waste disposal options other than open burning can be developed. These may include the promotion of lower cost and easier alternatives as well as increased penalties associated with open burning.

- A second option is to educate consumers on the health and environmental effects of backyard burning through public education campaigns. Pollution prevention grants or support from local groups might be sought to help defray expenses. Local television stations might be contacted about running a news story on the hazards of open trash burning and its prevalence in the area. Other cost-effective alternatives may be to display educational information for the public in local restaurants, libraries, or grocery stores, or to link with local non-government environmental groups to publicize the issue in newsletters and announcements.

- A third option is to generate community support for local burn barrel ordinances and to encourage residents to assist in enforcement. This may be accomplished through community-based campaigns that inform the public of the hazards of backyard burning (see Option 2), the need for an ordinance, alternative disposal and recycling methods, and opportunities for the public to become involved. Presentations may be made at community meetings to inform governing councils and residents of the need for a burn barrel ordinance and to gain their support. Such programs may be organized through a collaboration of local officials from environmental program offices, local health and/or fire departments, public works divisions, and solid waste offices, or through chambers of commerce, universities, or public interest groups. Information on the implementation of successful ordinances could be prepared and distributed to other communities.

Source Characterization

HCB has been identified as a residue level contaminant in the wood preservative pentachlorophenol (also known as "penta" or "PCP"), which is primarily used to treat utility poles. The use of PCP as a pesticide is restricted to wood uses only. EPA permits HCB concentrations in PCP no greater than 75 ppm (WLSSD, 1998). HCB in PCP-treated utility poles is thought to volatilize from the wood and may have the potential to leach and contaminate the surrounding soil. PCP-treated utility poles past their useful life may be used to build decks, gardens, and playground equipment, or may be stored at utilities. All of these options for end-of-life use have the potential for leaching HCB into the environment at the storage/use site.

Reduction Options

Under FIFRA, EPA is currently evaluating PCP for re-registration. This evaluation will result in a Re-registration Eligibility Decision Document (RED), due to be released in 2000, that will determine any revisions in regulatory requirements relating to PCP use. The results of the RED process could impact the feasibility of various pollution prevention and emission reduction options.

A workshop on alternatives to PCP-treated utility poles in the Great Lakes Basin is currently being considered by the Binational Toxics Strategy Pesticides Workgroup. Potential topics on the workshop agenda may include alternatives to the use of PCP to treat utility poles, the economic and operational impacts of the alternatives, and strategies for ensuring proper end-of-life disposal of PCP-treated utility poles.

Source Characterization

The source of HCB at publicly owned treatment works (POTWs) may be domestic (residential) releases, industrial/commercial discharges, and/or sewer runoff. Residue from pesticide application contributes to contamination via runoff. HCB may also result from the resuspension of contaminated sediments or from the use of HCB-containing ferric chloride in treatment operations (Benazon, 1999; WLSSD, 1998). HCB is also released during the incineration of sewage sludge and volatilization from sewage sludge that is land-applied or dried on-site. Air pollution controls on sewage sludge incinerators, however, may limit potential HCB emissions.

Ferric chloride is a chemical that is used in wastewater treatment and water purification for odor control and to facilitate settling of particles in the water. Its use may contribute to the release of HCB from publicly owned treatment works. Although the source of HCB contamination of ferric chloride has not been determined, it may be due to its manufacture from low-grade hydrochloric acid (HCl) from industrial processes (WLSSD, 1998).

Reduction Options

Since there are potentially many sources of HCB to POTWs, and significant resources are necessary to train and maintain staff in implementing POTW pollution prevention programs, it may be necessary that a broad array of toxic chemicals be targeted in POTW monitoring and toxic reduction efforts. These pollution prevention programs can focus on the sources of HCB to POTW facilities, as well as other problem chemicals such as mercury, and work with waste generators to reduce toxics in the waste stream.

Previous work on toxic chemical reduction efforts for wastewater treatment plants may inform the development of POTW pollution prevention programs. The Michigan Department of Environmental Quality, through a grant issued by the U.S. Environmental Protection Agency Great Lakes National Program Office, developed a pollution prevention training module for industrial and municipal wastewater treatment plant operators. The written course materials developed through this grant address pollutants of concern in the Lake Superior basin (including HCB), the impact of pollutants on wastewater treatment plant operations, and pollution prevention practices that reduce or eliminate the generation of these substances. The training materials are available on the Internet at http://www.deq.state.mi.us/ead/potw/.

Using a grant from the U.S. Environmental Protection Agency Great Lakes National Program Office, the Western Lake Superior Sanitary District (WLSSD) in Superior, Wisconsin worked with four pilot communities to develop and implement community toxic reduction plans. As part of this project, WLSSD developed a short presentation for wastewater treatment plant managers and operators on the regulatory need to reduce toxics in POTW discharge and the advantages of pollution prevention. Results of the project include written reports of the toxic reduction plans developed for each of the four pilot communities. Similar community toxic reduction programs, focusing on pollution prevention efforts to reduce HCB and other toxics, may be developed in cooperation with other local POTWs. More information concerning the four pilot community plans may be obtained from WLSSD at (218) 722-3336.

Another reduction option is to assess the need for regulatory limits on the HCB content of ferric chloride. Alternatively, POTWs can test for HCB in ferric chloride at their facilities and use or purchase only ferric chloride that does not contain HCB. The potential for reducing HCB emissions is not known due to the lack of information concerning the number of POTWs that use HCB-contaminated ferric chloride and the HCB content of the ferric chloride used. However, identifying the source of HCB contamination may help in efforts to reduce larger sources (i.e., HCl production) of HCB release.

The potential for HCB to volatilize from land-applied sewage sludge suggests the need to consider alternative forms of disposal. Options include restricting land-applied sewage sludge to that from non-industrial communities, and landfilling or incinerating sewage sludge from heavily industrial cities.

D B D V R R 1 T V

Source Characterization

Current evidence suggests that HCB undergoes long-range transport and that international sources contribute to HCB levels in the Great Lakes Basin. In a 1995 study by Cohen et al., measured concentrations of HCB in ambient air in the Great Lakes were higher than values computed from local sources by an air transport/deposition modeling program. Comparison of actual concentrations of HCB to values computed by the modeling program suggests that, in addition to the HCB generated by local identified sources, HCB is carried into the Great Lakes region from sources outside the U.S. and Canada (Cohen et al., 1995).

Reduction Options

Since the amount of HCB contributed from foreign sources is currently unknown, quantitative estimates of reductions from actions aimed at reducing foreign releases of HCB are uncertain. However, the general contribution of global sources of HCB to the Great Lakes has already been recognized. Recommended options to reduce HCB from international sources involve cooperative efforts, many of these through current programs or initiatives. These include the development of a North American Regional Action Plan under the Sound Management of Chemicals Program. The North American Working Group of the program is responsible for establishing cooperative mechanisms by which Canada, Mexico, and the U.S. will improve their management of chemicals. This group has approved HCB as a candidate substance for the development of a North American Regional Action Plan. Participation in this program, and the sharing of information and results from Binational Toxics Strategy efforts, should enhance the effectiveness of the North American Regional Action Plan for HCB. An explanation of the Sound Management of Chemicals Program is provided on the Commission for Environmental Cooperation's web site at http://www.cec.org.

The United Nations' Economic Commission for Europe Convention on the Long Range Transboundary Air Pollution (LRTAP) Protocol on Persistent Organic Pollutants (POPs) outlines commitments for signatories to "control, reduce, and eliminate discharges, emissions and losses of persistent organic pollutants", including HCB. Although the protocol does not outline any numerical emission limits for HCB (because so far, few countries have emission inventories), it commits signatories to developing and improving emission inventories and reducing HCB emissions to baseline emission levels selected by each country. The application of limit values and best available techniques are legally binding and enforceable for both new and existing stationary sources eight years after the protocol is ratified by 16 countries. Binational Toxics Strategy involvement in LRTAP efforts might include sharing information that supports the development of emission inventories and reduction goals for HCB.

The United Nations Environment Program Global Treaty on Persistent Organic Pollutants (UNEP POPs Treaty) is another current international effort with which the Binational Toxics Strategy HCB Workgroup may cooperate to help reduce long-range transport of HCB. Negotiations are currently underway to prepare an international legally binding agreement on the control and reduction of POPs, including HCB. As the agreement currently stands, member countries will be required to identify and quantify emission sources for all listed POPs, develop action plans for reduction, and make information available to the general public. The treaty will incorporate capacity-building activities to aid less well-developed countries in achieving control and reduction goals.

EPA's Agency-wide Multimedia Strategy for Priority Persistent, Bioaccumulative, and Toxic (PBT) Pollutants (PBT Strategy) provides another avenue for the HCB Workgroup to participate in global efforts to reduce HCB. As called for in the PBT Draft National Action Plan for HCB, EPA will seek to establish partnerships with international organizations (e.g., World Wildlife Fund), non-government groups (e.g., NRDC), and foreign governments to reduce long-range transport from sources contributing to atmospheric loadings of HCB. This includes fostering the proliferation of control technology, waste minimization, and pollution prevention opportunities. More information about the PBT Initiative can be found at http://www.epa.gov/pbt/.

This section seeks to demonstrate the feasibility and merit of pollution prevention opportunities such as those identified in this report. More companies might be willing to implement pollution prevention measures if they are aware of the potential cost savings, in addition to the environmental benefit, involved. Three companies that have successfully implemented HCB reduction projects are recognized. This not a comprehensive list, and it is acknowledged that other successful reduction efforts have been implemented by both the private and government sectors to help bring about the reductions already achieved in HCB environmental levels. In particular, many facilities, for various reasons (e.g., MACT regulations), have achieved reductions through the implementation of add-on controls.

Dow Chemical Company has taken several steps to achieve reductions in HCB releases. First, Dow has set a goal to reduce HCB emissions/releases to air and water by 75 percent by the year 2005. Plans for meeting this goal have not yet been determined. Second, improvements at Dow's former Scott Road landfill in Sarnia, Ontario, have eliminated releases of HCB to the St. Clair River from historical contamination at the site. Major work conducted as part of this improvement project included installation of new pile walls, a municipal sewer, and a cap for the landfill site. Third, Dow participated in a two-year project, labeled the Michigan Source Reduction Initiative, which involves the Natural Resources Defense Council (NRDC), Dow Chemical, and a group of local environmental activists working together to prove that pollution prevention can be cost effective. Chemical engineering consultants helped the parties examine 13 product lines at Dow's chemical manufacturing plant in Midland, Michigan, to identify opportunities for reducing pollution by finding less harmful solvents, reusing or recycling waste, or altering production methods. The project required a one-time expense of $3.2 million and is estimated to provide a savings of $5.3 million per year for Dow. Another success of this joint project was a 43 percent reduction in toxic emissions from the implementation of pollution prevention measures. While it is unclear to what degree HCB is among the toxic chemicals reduced through this project, the ability of the disparate groups to collaborate in demonstrating that pollution prevention can be cost effective illustrates the potential of collaborative partnerships. More information about the NRDC/Dow partnership can be found at http://www.nrdc.org/cities/manufacturing/msri/intro.asp.

A second example of a successful voluntary initiative is provided by Zeneca, which manufactures the pesticide chlorothalonil. Zeneca has improved its manufacturing processes to reduce the HCB content of this pesticide from a maximum of 500 ppm to an average of 22 ppm (Benazon, 1999). This results in a reduction of HCB releases from application of this product, particularly in the Lake Erie basin, where chlorothalonil has been used heavily (Brody et al., 1998).

The third example involves Monsanto, a major manufacturer of high-performance chemicals, agricultural products, food ingredients, industrial process control equipment, and pharmaceuticals. From 1990 to 1994, Monsanto completed more than 250 projects to achieve a 55 percent reduction in TRI chemicals (USEPA, 1997b). By eliminating more than 5 million lbs of waste, a new production process at Monsanto saved $4 million a year and earned the company a "Green Chemistry Challenge" Award from EPA.

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